1. Distinguish between the terms 'solute' and 'solvent.' Give an example of a solution and identify each component.

2. Distinguish between 'homogenous' and 'heterogeneous' mixtures. Give an example of each.

Review Appendix C (Molarity) if you need help on Exercises 3-8.

3. What is the concentration of nitrate ion in each of the following solutions?
   a) 0.25 M KNO_3 b) 0.10 M $Al(NO_3)_3$ c) 0.20 M $Ca(NO_3)_2$

4. What is the concentration of all ions in each of the following solutions?
   a) 0.16 M $CaCl_2$ b) 0.080 M Na_2SO_4 c) 0.060 M KBr

5. A solution is prepared by dissolving 25.0 g of sodium sulfate in enough water to prepare 250 mL of solution.
   a) What is the molarity of sodium sulfate in the solution?
   b) What are the molarities of the sodium and sulfate ions in the solution?
   c) How many moles of sodium ions are present in 17 mL of the solution?

6. A solution is labeled 0.0650 M K_3PO_4.
   a) How many moles of K^{1+} ions are present in 500 mL of this solution?
   b) How many moles of PO_4^{3-} ions are present in 500 mL of this solution?
   c) How many grams of K_3PO_4 are present in 50 mL of this solution?

7. A solution of K_2SO_4, which has a volume of 75.0 mL, contains 0.0048 moles of potassium ions. What is the molarity of the K_2SO_4 solution?

8. What mass of KCl is required to make 45 mL of a 0.13 M KCl solution? How many moles of chloride ion are present in the solution?

9. What are the two steps involved in solvation?

10. Explain the meaning of *like dissolves like*.

11. Explain the hydrophobic effect.

12. Indicate whether each of the following substances are more soluble in H_2O or C_6H_{14}:
    a) KI   b) C_8H_{18} c) grease   d) $CH_3(CH_2)_{12}OH$

13. Indicate whether each of the following substances are more soluble in H_2O or C_6H_{14}:
    a) HF   b) CH_3OH c) $NaC_2H_3O_2$ d) CH_4

14. What are the characteristics of a good detergent?

15. Differentiate between a monolayer and a micelle. Under what conditions is a detergent expected to form in each?

16. Represent $CH_3(CH_2)_{15}COONa$ with symbol shown in Figure 10.4d.

17. Identify each of the following as a weak, strong, or nonelectrolyte:
    a) CCl_4 b) NH_4NO_3 c) H_2CO_3 d) HNO_3 e) CH_3OH

18. Identify each of the following as a weak, strong, or nonelectrolyte:
    a) KF   b) CH_3Cl c) HF   d) NH_3 e) CH_3COONa

19. What are the predominant solute species in aqueous solutions of the following? Write the molecule or the separated ions as appropriate.
    a) CO_2 b) $CaCl_2$ c) PF_3 d) $K_2Cr_2O_7$ e) KOH

20. What are the predominant solute species in aqueous solutions of the following? Write the molecule or the separated ions as appropriate.
    a) $CoCl_3$ b) $Pb(NO_3)_2$ c) NH_4F d) C_2H_5OH e) BrF_3

21. What is the ratio of the force of attraction experienced by Ca^{2+} and SO_4^{2-} to that experienced by Al^{3+} and Cl^{1-}? Assume that the ions are the same distance apart and in the same medium.

22. What is the ratio of the force of attraction experienced by Na^{1+} and Cl^{1-} to that experienced by Al^{3+} and P^{3-}? Assume that the ions are the same distance apart and in the same medium.

23. What property of water makes it a good solvent for ionic compounds? How is this property expressed in Coulomb's Law?

24. Which solid(s) can be used to make a solution that is 0.1 M in Pb^{2+} ions?
    a) $Pb(ClO_4)_2$ b) $PbCl_2$ c) $PbCrO_4$ d) $PbCO_3$ e) PbS

25. Which solid(s) can be used to make a solution that is 0.1 M in Zn^{2+} ions?
    a) $Zn(ClO_4)_2$ b) $ZnCl_2$ c) $ZnCrO_4$ d) $ZnCO_3$ e) ZnS

26. Which solid(s) can be used to make a solution that is 0.1 M in SO_4^{2-} ions?

a) $PbSO_4$ **b)** K_2SO_4 **c)** $CuSO_4$ **d)** $BaSO_4$ **e)** $FeSO_4$

27. Which solid(s) can be used to make a solution that is 0.1 M in CrO_4^{2-} ions?

a) $ZnCrO_4$ **b)** K_2CrO_4 **c)** $CuCrO_4$ **d)** $BaCrO_4$ **e)** $FeCrO_4$

28. A student finds two unlabelled jars, one is $BaSO_4$ and the other is Na_2SO_4. Suggest an easy way to determine which jar contains Na_2SO_4.

29. A solution is known to contain one of the following cations: Na^{1+}, Ag^{1+}, or Fe^{2+}. The addition of chloride ion to part of the solution had no apparent effect, but addition of CrO_4^{2-} ion resulted in a precipitate. What is the identity of the cation in the original solution?

30. A solution is known to contain one of the following anions: Cl^{1-}, SO_4^{2-}, or NO_3^{1-}. What is the identity of the anion if a precipitate was observed with the addition of Pb^{2+}, but no precipitate forms with Ag^{1+}?

31. Write net equations for any precipitation reactions that occur when the following 0.1 M solutions are mixed or write 'no reaction' if appropriate.
   a) manganese(II) chloride + sodium sulfide
   b) iron(III) chloride + sodium carbonate
   c) potassium sulfide + zinc nitrate
   d) silver sulfate + barium iodide
   e) lead acetate + lithium hydroxide
   f) ammonium phosphate + copper(II) sulfate

32. Write net equations for any precipitation reactions that occur when the following 0.1 M solutions are mixed or write 'no reaction' if appropriate.
   a) potassium chromate + nickel(II) chloride
   b) cadmium nitrate + ammonium carbonate
   c) manganese(II) acetate + zinc sulfate
   d) lithium perchlorate + silver acetate
   e) barium nitrate + silver sulfate
   f) cesium hydroxide + iron(III) acetate

33. Write the chemical equation of the dissolution of the following salts in water and give the K_{sp} expression.

   a) FeS   **b)** $PbCl_2$ **c)** $Ca_3(PO_4)_2$

34. Write the chemical equation of the dissolution of the following salts in water and give the K_{sp} expression.:

   a) $Al(OH)_3$ **b)** Fe_2S_3 **c)** $CoPO_4$

35. What is the maximum concentration of Fe^{2+} ions that can exist in a solution in which $[OH^{1-}] = 1.0x10^{-7}$ M? K_{sp} $(Fe(OH)_2)= 8.0x10^{-16}$

36. What is the maximum concentration of Pb^{2+} ions that can exist in a solution which is 0.10 M in chloride ion? K_{sp} $(PbCl_2)= 1.7x10^{-5}$.

37. What is the K_{sp} of AgCN if the concentrations of silver and cyanide ions in a saturated solution of silver cyanide are each $1.1x0^{-8}$ M?

38. What is the K_{sp} of $BaCO_3$ if the concentrations of barium and carbonate ions in a saturated solution of barium carbonate are each $9.0x10^{-5}$ M?

Review Appendix D4 if you need help on Exercises 39 - 42.

39. A student mixes 1.50 L of 0.20 M K_2CrO_4 and 1.20 L of 0.30 M $AgNO_3$.
   a) Write the net reaction that occurs.
   b) How many moles of CrO_4^{2-} ion were added?
   c) How many moles of Ag^{1+} ion were added?
   d) How many moles of Ag_2CrO_4 precipitate?
   e) How many grams of Ag_2CrO_4 precipitate?

40. A student mixes 25.0 mL of 0.20 M KCl and 15.0 mL of 0.30 M $Pb(NO_3)_2$.
   a) Write the net reaction that occurs.
   b) How many moles of Cl^{1-} ion were added?
   c) How many moles of Pb^{2+} ion were added?
   d) How many moles of $PbCl_2$ precipitate?
   e) How many grams of $PbCl_2$ precipitate?

41. A student mixes 0.36 L of 0.10 M $Ba(ClO_4)_2$ and 0.52 L of 0.10 M Na_2SO_4.

   a) Write the net reaction that occurs.

   b) How many moles of SO_4^{2-} ion were added?

   c) How many moles of Ba^{2+} ion were added?

   d) How many moles of $BaSO_4$ precipitate?

   e) How many grams of $BaSO_4$ precipitate?

42. A student mixes 78 mL of 0.17 M $Fe(NO_3)_3$ and 85 mL of 0.20 M Na_2CO_3.

   a) Write the net reaction that occurs.

   b) How many moles of CO_3^{2-} ion were added?

   c) How many moles of Fe^{3+} ion were added?

   d) How many moles of $Fe_2(CO_3)_3$ precipitate?

   e) How many grams of $Fe_2(CO_3)_3$ precipitate?